Central Control and Monitoring System 25.13.00

Description:

The purpose of the section is to describe the University of Maryland's Central Control and Monitoring System (CCMS) and Building Automation Systems (BAS). This section is to apply to all new construction and renovation projects that involve automated control of building systems.

These guidelines are intended to assist in-house construction project management teams, outside design professionals, automation vendors, construction management firms, etc. involved in the design, procurement and/or installation of control, monitoring or building automation systems at the University of Maryland, College Park.

Related Sections:

- TBD

Effective Date:

January 1, 2020

Applicable Standards:

- TBD

General Requirements:

The University of Maryland's Central Control and Monitoring System (CCMS) is configured as a network with control functions at multiple levels, and with multiple points of operator control and supervision. The BAS includes centralized head-end servers, data transmission systems, field panels and controllers, necessary interfacing controls, sensors and actuators. The controllers contain microprocessors and other supporting electronics that perform local.

UMD CCMS ALC Servers

ALC Operational Server

- The UMD College Park CCMS group shall maintain an Operational server for projects accepted and turned over to the university.
- The CCMS group shall be responsible for maintaining the drivers and software updates, user access and alarm routing and messaging.
- When a project has been complete, or from a request of the CCMS group, the contractor shall remove the projects database from the construction server and place it onto the production server. The ALC BAS contractor shall be responsible for confirming that functionality is preserved and navigation links are integrated into the existing navigation tree.

ALC Construction Server

- In addition to an operational campus wide WebCtl production server, the UMD College Park CCMS group shall maintains a Construction server for the ALC BAS contractors use for during the construction phase of a new or major renovation of an existing building.
- The ALC BAS contractor shall use the construction server for their project development and commissioning and for UMD facility management access during the pre-acceptance project phase. Access by other entities shall be managed by the ALC BAS contractor with c oordination with the CCMS group.

When the project is 100% complete, or from a request of the CCMS group, the contractor shall move the projects database from the construction server to the production server.

The ALC BAS contractor is responsible for maintaining the Construction Servers drivers and software updates.

UMD CCMS Tridium N4 Server

Tridium N4 Server

- The Tridium N4 BAS contractors shall develop the building BAS so that monitoring and control, scheduling, alarming and trends shall function without dependence on the Tridium N4 Server.
- Additional graphics scope shall be developed for the CCMS N4 server using CCMS approved graphic package. Scope shall include Niagara discovery and graphical representations defined at N4 server for all buildings under platform.
- The ALC BAS contractor is responsible for maintaining the Construction Servers drivers and software updates.

Below is the Staefa Talon BAS local representative contact information.
Capron Company, Inc.
411 N Stonestreet Ave
Rockville, MD 20850
(301) 424-9500
Steve Ferrick - SFerrick@capron.com

Smart Building Technologies
4800 Hampden Lane, Suite 200
Bethesda, MD 20814
(240) 482-3706
Journey Williams - journeyw@smartbuildingtec.com

Below is the Automated Logic BAS local representative contact information.
EMS Technologies, LLC
DBA Albireo Energy, LLC
2134 Espey Court, STE 5-9
Crofton, MD 21114
(443) 430-4793
Jacob Hogan – jhogan@albireoenergy.com

Building Automation Control (BAS) Submittal Documentation

- The BAS control Operation and Maintenance (O&M) documentation shall include the following:

Index
Building Communication Architecture Riser Diagram*
Building Riser Diagram of supply, return and exhaust systems
Building Riser Diagram of terminal unit systems
Point Schedule
Flow Diagram
Sequence of Operations
Control Panel and Terminal Unit controller Wiring Diagrams**
Device Schedule
Valve Schedule
Damper Schedule

* As applicable to existing infrastructure, new work shall append previous phase.
** Control Panel Wiring Diagram may be excluded from BAS Submittal documentation however As Built diagram are required for O&M document.

- **ATC Sensor and Control Relay Tagging**
  All ATC Sensors and Control Relays shall be identified by an exterior tag, consistent with identification within the ATC O&M manual. Control conduit will be identified by green conduit and covers.

  Equipment Sequence of Operations
  For Design Build projects, the universities CCMS group shall provide standard Sequence of Operations, Flow Diagrams, Point Schedules and Hardwired safety interlocks details as basis of design for the following system:
  - Hot Water HX Systems
  - Chilled Water HX Systems
  - Constant Volume
  - Variable Volume
  - % Outside-Air Unit
  - Lab Exhaust System

Variable Volume Terminal Unit Emergency Demand Response Sequence of Operations
The ATC system shall be programmed to include three building wide global/group demand limiting command levels to allow the CCMS operator, with administrator password access, to manually initiate the demand limiting sequence. The sequence shall be written to allow for additional logic allowing automatic level indexing in addition to the manual user intervention.

INDEX

- **Training and Demonstration**
  - System demonstration of ATC system shall occur prior to final owner training.
  - The contractor shall demonstrate, in a round table session with CCMS, system functionality by perform primary control functions, graphical representation, and review of all associated links, in accordance with CCMS BAS O&M manual documentation.
  - The time accrued to perform a successful demonstration shall be credited toward training hour requirement.
  - Minimum of 8 hours should be estimated for any project.

- **Computer Hardware**
  - Whenever specification calls for computer hardware, CCMS preferences are as follows:
  - Dell/ HP/Lenovo professional, mid-grade, laptop with the minimum criteria with backpack style carrying case.
    HDD storage capacity: 1 Terabyte, solid state
    RAM capacity: 16GByte
    Screen size: 15.6" High Definition (720p) LED Display

    (Current Windows Professional Operating System)

- **Trend Database Definitions**

  The following represents the default trend history data interval criteria:
  - Analog point types shall have a sample interval of 15 minutes with a minimum of 192 samples, First-In First-Out (FIFO) sliding window within the controller.
  - Binary and Multi-State Variable point types shall be defined to record Change of State and Change of Variable respectively.
  - File upload to the server shall automatically be performed on a daily basis.
  - Trend data uploaded to the primary server level shall be maintained indefinitely.

  The following represents the default trend data definition criteria:

  LAB Exhaust Systems:
  Fan Command (DO)
  Fan Status (DI)
  Duct Static Pressure (AI) (If Applicable)
  Air Volumes (AI) (If Applicable)
  VFD Speed (AO) (If Applicable)
  Bypass Damper Control Position (AO) (If Applicable)

  Variable Volume HX/Pumps:
  Pump Command (DO)
  Pump Status (DI) or AI (Amps)
  Supply Temperature (AI)
  Return Temperature (AI)
  System Pressure (AI)
  Flow (AI) (If Applicable)
  VFD Speed (AO)
  Bypass Valve Control Position (AO)

Constant Volume HX/Pumps:
Pump Command (DO)
Pump Status (DI) or AI (Amps)
Supply Temperature (AI)
Return Temperature (AI)

Constant Volume Air Handling Unit:
Fan Command (DO)
Fan Status (DI) or AI (Amps)
Zone Temperature (AI)
Supply Temperature (AI)
Return Temperature (AI)
Mixed Air Temp (AI)
Freeze Stat (DI)
Valve Control Position (AO)

Variable Volume Air Handling Unit:
Fan Command (DO)
Fan Status (DI) or AI (Amps)
Duct Static Pressure (AI)
Supply Temperature (AI)
Return Temperature (AI)
Mixed Air Temp (AI)
Air Volumes (AI) (If Applicable)
Freeze Stat (DI)
Duct Static Pressure Setpoint (SP) (If Optimized)
Supply Temperature Setpoint (SP) (If Optimized)

Variable Air Volume (VAV) terminal unit:
Zone Temperature (AI)
Supply Temperature (AI)
Air Volume Input (AI)
Air Volume Setpoint (AI)
Cooling %
Heating %
Occupancy

- **Air Flow Monitoring Station (AFMS)**
- It is our preference that AFMS are not used as a control process variable and only for monitored purposes.
- In general, it is recommended to use fan house probes for Single Wide Single Inlet (SWSI) and Double Wide Double Inlet (DWDI) centrifugal fans rather than Duct probes.
  - When identified on the mechanical drawing, all AFMS' shall be thermal dispersion type by Ebtron Gold Series with LCD displays.
  - AFMS based on Pitot tube sensing are not acceptable.
  - Variable Air Volume (VAV) Air Handling Units (AHU) with supply and return fan shall monitor both the supply and return air flow using AFMS'.
  - Variable Air Volume (VAV) Air Handling Units (AHU) with only a supply fan shall, at minimum, monitor the outside air volume.
  - AFMS are not required for Constant Air Volume (CAV) Air Handling Units.
  - LCD display shall be visually accessible without the use of a ladder.
  - Air Flow volume shall be hardwired if used as an input process variable for control.

- **Static Pressure Transmitter**
  - Supply or exhaust duct mounted static pressure transmitters shall include an LCD display, tagged, and shall be mounted within the associated control panel.
  - The device shall be configurable for multi-range, 24vac power and voltage signal, 3 or 4 wire transmitters. Do not use 4-20 ma signal.
  - Duct static pressure probe shall be installed approximately 2/3 of the way down the air duct main trunk.
  - Pressure probe sensing locations shall be identified on automation control floor drawings and included in graphical user interface flow diagram representation.
  - Preference: Veris PX series
- **Wet Pressure Transmitter**
  - Wet pressure transmitters shall include an LCD display and shall be mounted, tagged and LCD display shall be visually accessible without the use of a ladder.
  - The device shall be configurable for multi-range, 24vac power and voltage signal, 3 or 4 wire transmitters. Do not use 4-20 ma signal.
  - Pressure probe sensing locations shall be identified on automation control floor drawings and included in graphical user interface flow diagram representation.
  - Device installation location shall be accessible from common area (in ceiling above a door to prevent future obstructions) or mechanical room (at eye level).
  - Isolation power supplies shall be required whenever two or more transmitters are associated with the same controller.
  - At minimum 3-port Manifold required unless using the Veris PWRLX03S010 with 10-20ft cables.
  - Burst Pressure must be 100 psi or greater.
  - Preference: Veris PW series
- **Humidity Sensors**
  - All AHU Duct mount Humidity Transmitters shall be by Vaisala; where applicable associated temperature transmitters shall be included with humidity transmitter. 24vac power and voltage signal, 3 or 4 wire transmitters. Do not use 4-20 ma signal.
  - All Office wall mounted sensor shall be by primary controller manufacture (ALC or Distech).
  - All Lab wall mounted sensor shall be by Vaisala.
- **Safeties**
  - AHU:
    All AHU safeties and associated controls shall be hard wired with manual reset whether the system is locally or remotely controlled and/or manually overridden for constant or variable speed fans.
  - Smoke Detectors
    When tripped, the unit smoke detector will stop the supply and return fans, close the minimum outside air, economizer dampers, and relief dampers and open the return air damper.
  - High/Low Static pressure safeties installation shall follow manufacturer's installation guidelines. Specifically, mounting orientation shall be observed and location of reset shall be accessible without the use of a ladder.
  - Freeze stat length shall, at minimum, be 1 linear foot per square foot of coil cross sectional area.
  - Freeze stat local trip setpoint shall be set for 36 °F.
  - Freeze stat installation shall follow manufacture installation guidelines.

Freeze stat Safety Circuit

- Freeze protection shall be required whenever there is a possibility of freezing the AHU water coils due to the exposure to outside air conditions.
- All AHU safeties and associated controls shall be hard wired with either integral or remote reset whether the system is locally or remotely controlled and/or manually overridden for constant or variable speed fans.

General

All AHU safeties shall be hard wired and shall override any local or remote control commands.

Safeties

Normally-Open (**NO**): Contacts connect the circuit when the associated relay is activated; the circuit is disconnected when the associated relay is inactive (or loss of power).
Normally-Closed (**NC**): Contacts disconnect the circuit when the associated relay is activated; the circuit is connected when the associated relay is inactive (or loss of power).
Contacts are shown in their Normal state.
On power loss the energized normally open pilot relay contacts shall open safety circuit placing the system into fail safe condition.
All safety circuits shall be wired in series.

The following safeties devices may be included in the safety circuit:

- Smoke
- Freeze
- High Static
- Low Static

100% Outside Air - AHU freeze safety circuit

100% OA units freeze safety are to be based on an auto reset freezestat wired into a timed delay relay (TDR) panel mounted reset and exterior mounted LED lamp indicating an alarm condition. Upon detection of a freeze condition, the automatic reset freezestat contacts shall open and initiate the timer of the TDR. Whenever the alarm condition exceeds the TDR time delay setpoint (2 minutes, adjustable) the associated contacts shall open the safety circuit.

When freeze circuit opens the following shall occur through hardwired interlocks:
Stop the supply fan
Spring close the outside air damper
De-energize NC control relay to start hot water coil pump motor.

When freeze circuit opens the following shall occur through automation:
The preheat water coil PID control loop shall be enabled allowing the associated valve to modulate as required to maintain the preheat coil leaving air temperature low limit set point (45F)
Command all other non-steam valves fully open. When Condensate Overflow Switch is present then associated non-steam valve shall close.

Mixed Outside Air - AHU freeze safety circuit

Mixed outside Air units freeze safety are to be based on a manual reset freezestat.
Upon detection of a freeze condition, the manual reset freezestat contacts shall open and immediately open the safety circuit.

When freeze circuit opens the following shall occur through hardwired interlocks:
Stop the supply and return fans
Spring close the minimum outside air, economizer and relief dampers
Spring open the return damper
De-energize NC control relay to start the hot water coil pump motor.

When freeze circuit opens the following shall occur through automation:
The Preheat Water Coil PID control loop shall be enabled allowing the associated valve to modulate as required to maintain the Preheat Coil Leaving Air Temperature low limit set point (45F).
Preheat Water Valve shall modulate open whenever the Mixed Air Temperature falls low limit set point (40F).
Command all other AHU water valves fully open. Do not command steam valves open.
All life safeties shall be hard wired and function according to the specified sequences whether the system is locally or remotely controlled and/or manually overridden.
All other safeties may be defined in the unit controller programming logic using BACnet priority array priority level 5, Critical Equipment Control, to perform the specified sequence whether the system is locally or remotely controlled and/or manually overridden.
Whenever Condensate Overflow Switch alarm is present then the programming logic shall stop the associated fan(s), close outside air damper, close any associated water valve(s), and send alarm to CCMS.
Condensate alarm shall take priority over freeze alarm condition requirement.

Control Panel Enclosures and Wiring

Control Panel Enclosures

All BAS controllers shall be housed in a Control Panel Enclosure, mounted directly onto panel backplane where stacking controllers is unacceptable.
All enclosures shall include:

- Terminal strips with numbers
- 20% of free space for future expansion of the system
- Hinged door with latch handle.
- Back plate firmly secured and grounded to the enclosure.
- Tagged mounted on exterior upper left hand corner of the panel door as identified in the BAS controls O&M manual
- Attach laminated control drawings, minimum 11 x 17, on the inside of the panel door
- Label Power source and breaker circuit number

Interior mechanical room enclosures shall be NEMA-12, steel, painted gray and finished to control oxidation.

All enclosures mounted in exterior or damaging environment shall be NEMA 4.

All NEMA 4 panels shall include:

- Thermostatically controlled fan and drip and insect screen protected vents
- Internal panel temperature monitored by BAS
- Penetrations sealed with mechanical bushing or knockout filler, protected with water sealing compound.

Control panel supply voltage shall not exceed industry standard 24 VAC and clearly identify fuse wiring, type, terminations and rating. Voltages greater than 24 VAC shall not be exposed within the control panel.

An associated electrical trough shall be installed for any panel enclosures greater than 16 inches wide.

All panels shall include laminated wiring diagram including details of terminations, modules, relays, switches, reset and push buttons, indicating lights, inputs and outputs, power supplies and network connections.

Control vendor shall conform to UMD CCMS internal wire color standards and codes. See Wiring Section below.

Wiring

All wiring shall be stranded copper, twisted pairs with shield insulated for compliance with National Electric Code including requirements when control wires are run in high voltage panels.

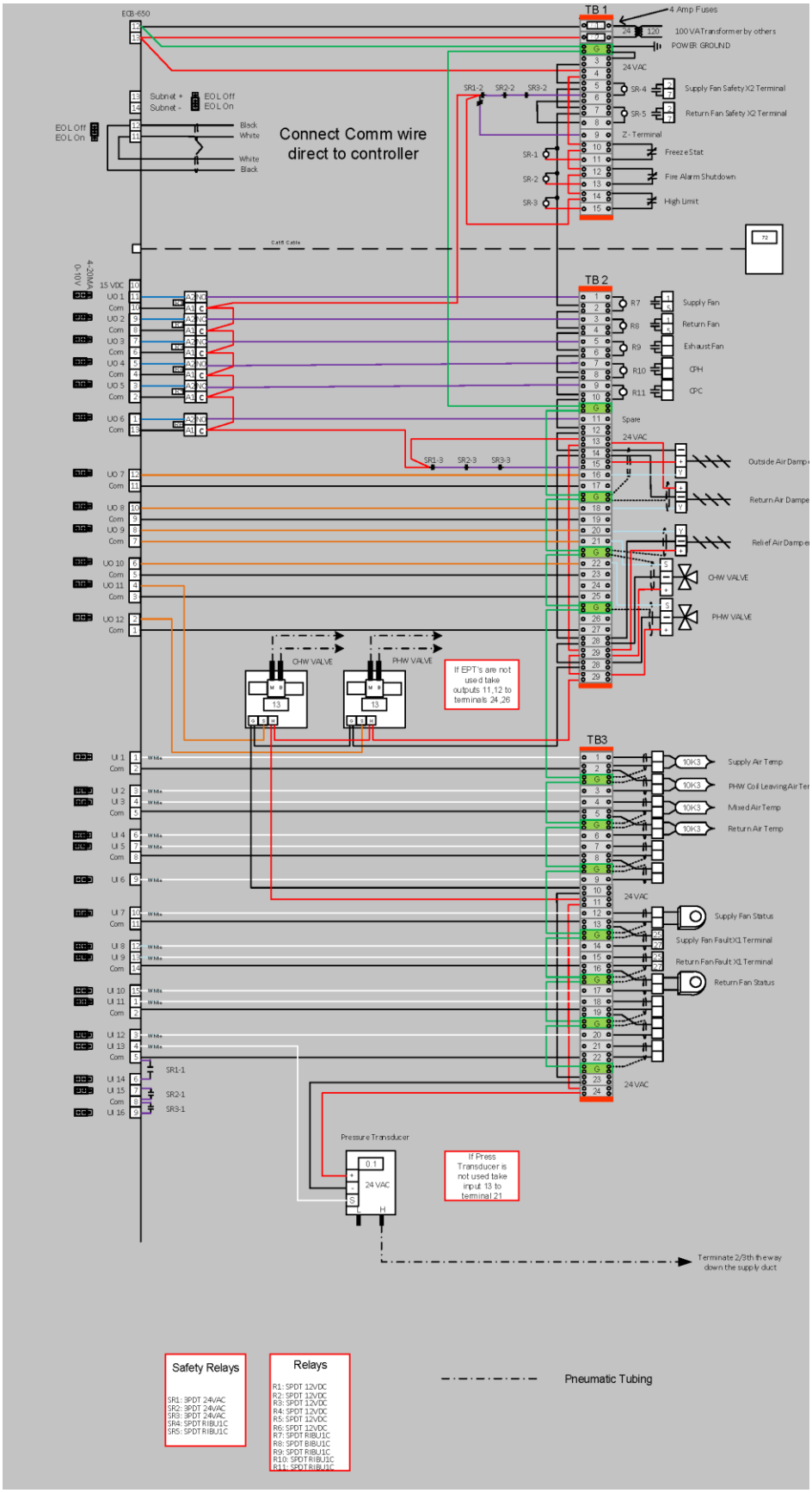
Solid wires are not acceptable. Use wire Stacon for all screw type terminations.
All sensing and control wiring shields shall be grounded at BAS control panel only.

Color code of control and sensor wiring inside BAS control panel:

Red - 24vac power
Black - 24vac common and input/outputs common
White - input signal wire
Orange - analog output signal wire
Blue - digital output from controller
Purple - output from relays inside of panel
Green - ground
Yellow - 24vdc positive
Brown - 24vdc negative

Jacket Color code of communication wiring inside BAS control panel:
Blue - Bacnet MSTP
Green - Arcnet
Yellow - Modbus MSTP
Red - (Cat5/6) CCMS own IP building network and IP controllers

Central Control and Monitoring System 25.13.00



- **Terminal Units (Variable Air Volume (VAV), Fan Coil Units (FCU))**

  Variable Air Volume (VAV)

  In general the majority of new VAV installations across campus are comfort cooling applications using conventional series, no fan powered terminal units with reheat coil and Pitot tube array.

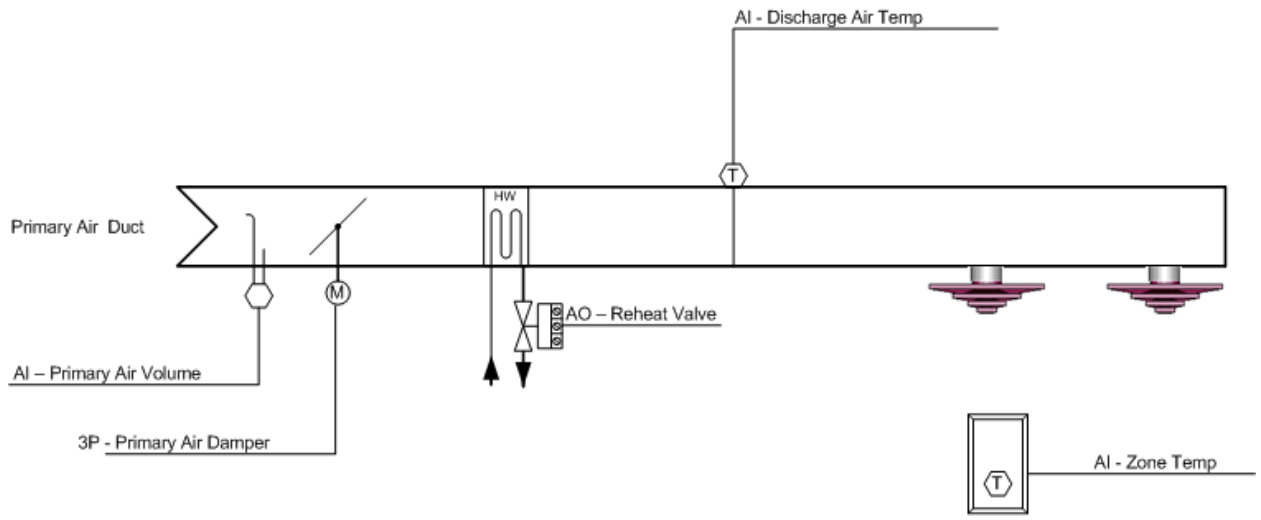
  The BAS controls contractor are responsible for providing and installing low speed volume control dampers actuators, modulating reheat valve, velocity probe, discharge air sensor and Zone Thermostat.

  BAS controls contractors controller shall be compatible with the associated BAS control system and associated control strategy shall be capable of Dual Maximum volume control.

  Reheat valve control actuator type shall be modulating 0-10 VDC. Floating point or pulse width modulation type actuators are not acceptable.

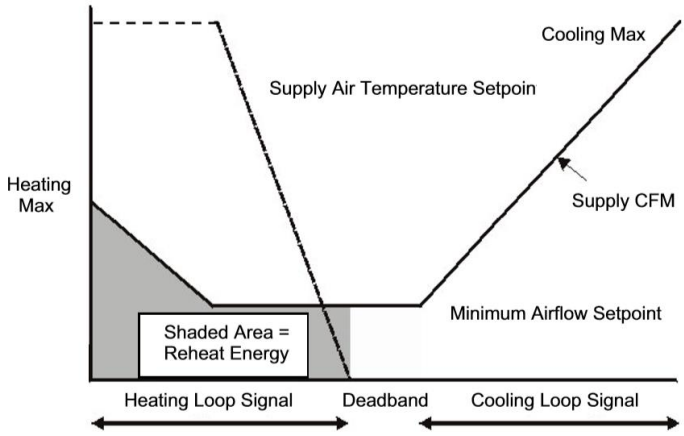
  If VAV terminal unit is “Cooling only” type where no Re-Heat Coil exists then Discharge Air Temperature (AI) is not required.

  When zone thermostats are specified to include setpoint adjustment or Occupancy sensors the defaults shall be disable until commissioning has been performed.



VAV Terminal Unit with Reheat

VAV Hot Water Reheat Box – Dual Maximum



Fan Coil Units (FCU)

The Fan Coil Unit base of design shall consists of a variable speed fan; using an electronically commutated motors (ECM) motor; modulating chilled and hot water coil valves, condensate pan high level and filter status.

The BAS controls contractor are responsible for providing and installing modulating chilled and reheating valve and all sensor and controlled points including Zone Thermostat with temperature setpoint adjust and Occupancy sensor.

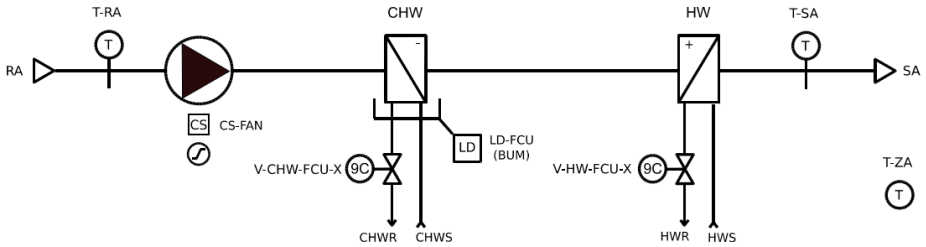
BAS controls contractors controller shall be freely programmable within the associated BAS control system and the universities CCMS group may elect to provide associated control strategy program.

Control valve actuators shall be modulating 0-10 VDC. Floating point or pulse width modulation type actuators are not acceptable.

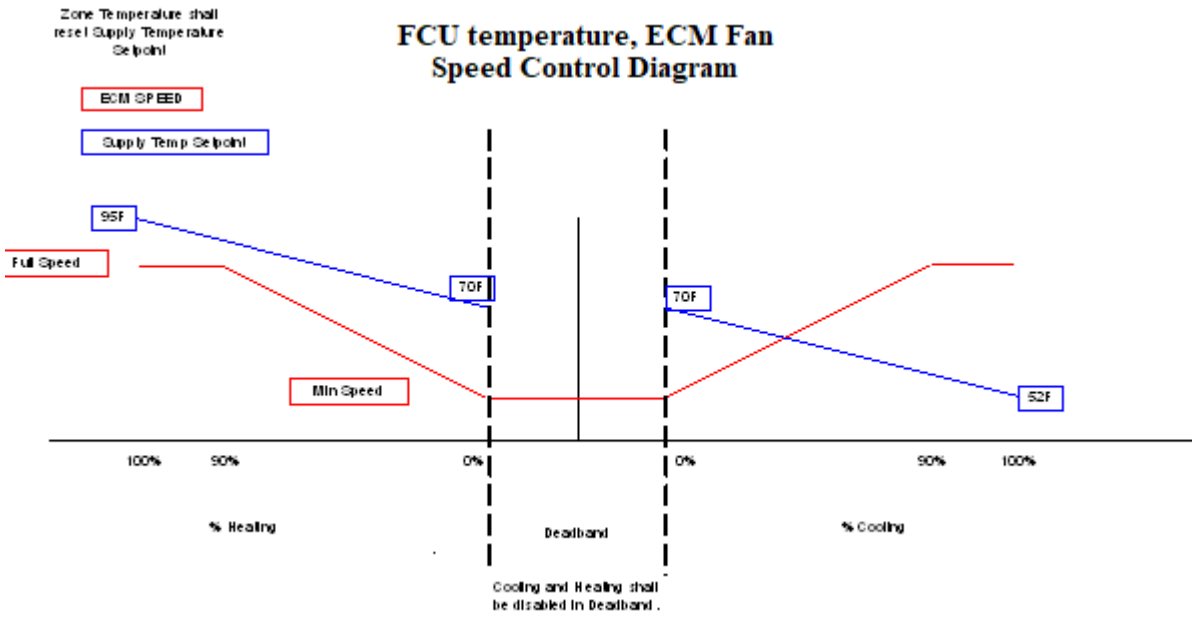
Where multiple FCU are in same environmental space Master/Slave control strategy shall be applied to prevent simultaneous heating and cooling.

Fan Coil ECM motor speed control should include air balancing confirmation with design intent.

When zone thermostats are specified to include setpoint adjustment or Occupancy sensors the defaults shall be disable until commissioning has been performed.



Typical Fan Coil Unit Flow Diagram



- **Global Points**

  Process variable inputs of Proportional Integral & Derivative Control loops shall be a hardwired input type wired directly into the associated controller.

  Unless approved in advance by CCMS, PID process variable input shall not be delivered across the controller network.

  Weather Service outside air data shall not be used for control inputs or decisions.

- **Graphical Equipment Representation**

  All fans and pumps shall include animated graphical representations based on operating input status. Additionally, these representations shall include text indicating input and output status.

  University shall expand on GUI criteria

- **BACnet Campus Addressing Scheme**

  Each BACnet Device Object Instance on the Campus Intra-network has to be exclusive for each device. Within the University Of Maryland, College Park Campus managed IP networks two IP subnet domains have been allocated for the CCMS BAS Systems (10.136 and 10.137 for ALC, and Tridium 128.8 and 129.2).

  Tridium BAS

  The Tridium BAS contractors shall follow the BACnet Network and Device Instance numbering format scheme below:

  - BACnet Device Object Instance range: (1000000 – 4099999)

NNBBBDD

- NN: Network Number (10-40) (Routing Prefix)
- BBB= Building Number (000-999)
- DD: Device ID (MAC Address)

The Tridium BAS contractors shall coordinate with the CCMS System group for network communication topology and BACnet numbering for existing BAS infrastructure. Further, these contractors shall use the Niagara communication protocol, not BACnet, to pass data between the Tridium N4 Server and the building JACES. BACnet data shall only be transferred within the Building BAS topology.

The BAS contractor shall coordinate with the CCMS System group for network communication topology and BACnet numbering for existing BAS infrastructure and for instances where 3rd Party integrated systems cannot be addressed in accordance with the established BACnet addressing format.

Note:

- A BACnet network is made up of one or more IP subnets.
- Devices do not know, or at least do not need to know, their BACnet network number (unless the device is a BACnet router).
- Devices have a unique address.
- Media Access Control (MAC)

ALC WebCtl BAS:

The ALC WebCtl BAS contractors shall conform to the following BACnet Network and Device Instance numbering format scheme, based on Cornell model as described in the Nov 2007 ASHRAE Journal.

Where after reviewing the controls submittal and validating the network architecture for a given project the university would then allocate a range of BACnet Network Numbers and Device Instance Numbers based on the following:

The format for the **Network Number** is **SFFFN** where

S=Site (1=Main Campus, 2=Main Campus Extended Network, 3= Off Campus)
FFF= Facility (Building) Number (Always 3 digits – range 000-999)
N=Network Number (Always 1 digit - range 0-9)

The format for the **Device Instance Number** is SFFFN**DD** where

DD=Device Number (Always 2 digits - range 00-99)

In case where multiple routers are used in a building (FFF) the S and N digits may be combined to extend the network (range 10-39)

The BAS contractor shall coordinate with the CCMS System group for network communication topology and BACnet numbering for existing BAS infrastructure and for instances where 3rd Party integrated systems cannot be addressed in accordance with the established BACnet addressing format.

- **Documentation**

The CCMS BAS controls contractor shall comply with the contract submittal requirements for content and quantity. Further, the CCMS BAS controls contractor shall provide O&M documentation in editable digital format.

Hard copies of O&M documentation not required.

Laminated control drawings printed size shall not be less than 11 x 17.

Laminate drawings of JACE Panels shall detail associated building BAS IP Topology.

All project ATC O&M documentation shall be sent to CCMS operations supervisor (301-405-3244).

ATC vendor shall provide a single Point of Contact for all project documentation.

- **CCMS Point Naming Convention Approval**

  The ATC contractor shall follow the following naming convention

  Unit type-Building Number-Floor-Unit Number

  Where Unit Type: (AHU=Air Handler Unit, EF=Exhaust Fan, CH= Chiller, CT= Cooling Tower, CHWP= Chilled Water Pump, CWP= Condenser Water Pump, FCU= Fan Coil Unit, VAV= Variable Air Volume)

  Example, AHU-077-02-04 represents AHU#4 in building 077, located on the second floor.

  If the contract drawings do not conform to this format please contact the CCMS operations supervisor (301-405-3244) for clarifications.

- **Variable Frequency Drives (VFD) Monitoring and Control**

  All VFDs' shall be monitored by the building automation system by an industry standard integration protocols (BACnet or Modbus).

  All points necessary for the primary automated control functions of a VFD shall be hardwired to the building automation local controller.

  The VFD hard wired points shall include the following points:

  Run Status (Analog current Input)

  Run Command (Digital Output)

  Speed Control (Analog Output)

  All safeties shall be hardwired through the VFD safety circuit and shall stop the VFD controlled motor whenever drive is in the Bypass, Hand, or Auto state.

  Disconnects for VFD driven motors are to be hardwired into the VFD monitoring circuit.

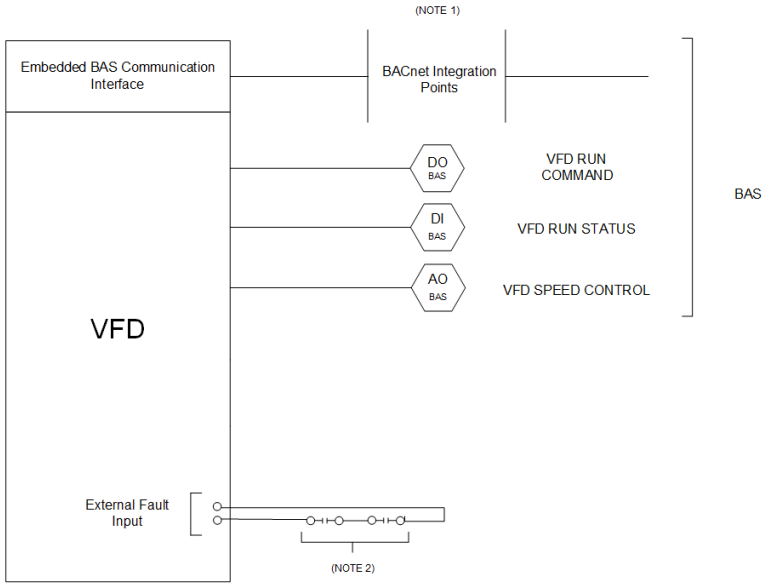
  Below is the general approach for interfacing VFD's with the BAS. Isolation dampers and other interlocks shall be hardwired to drive based on driver manufacturers user manuals recommendations.

  All VFD relays with pilot light indicators shall be mounted separately from VFD in a junction box with flexible conduit within 3 feet of VFD.

  No disconnect between VFD and motor.

  If application requires a local disconnect a safety interlock conduit and wiring must be installed to disable VFD.

  Any motor application shall use current transducer (amps) on load side. Software defined switch.



(NOTE 1)

All VFDs' shall be monitored by the building automation system by an industry standard integration protocols (BACnet or Modbus).

All points necessary for the primary automated control functions of a VFD shall be hardwired to the building automation local controller.

The VFD hard wired points shall include the following points:

VFD Run Command (Digital Output)
VFD Run Status (Digital Input)
VFD Speed Control (Analog Output*)

The Motor hard wired points shall include the following points:

Motor Run Status (Digital Input) by current Switch

* As an alternative, Pulsed Digital Outputs using floating point control may be applied.

Disconnects for VFD driven motors are to be hardwired into the VFD monitoring circuit.

Minimum Integration Points shall include the following:

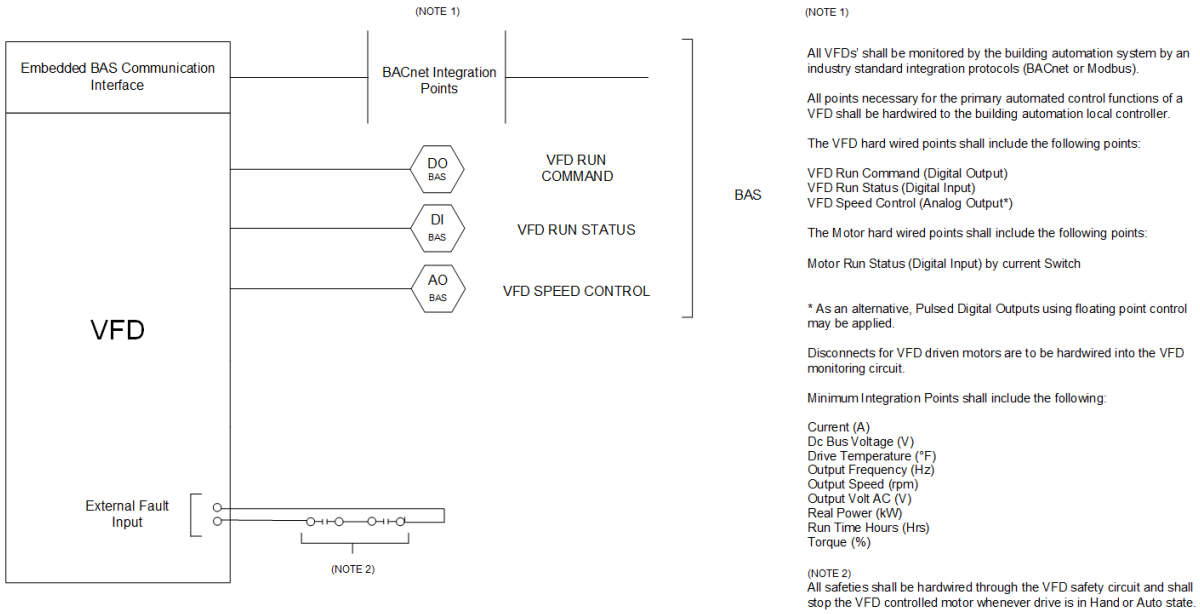
Current (A)
Dc Bus Voltage (V)
Drive Temperature (°F)
Output Frequency (Hz)
Output Speed (rpm)
Output Volt AC (V)
Real Power (kW)
Run Time Hours (Hrs)
Torque (%)

(NOTE 2)
All safeties shall be hardwired through the VFD safety circuit and shall stop the VFD controlled motor whenever drive is in Hand or Auto state.

BAS/VFD CONNECTIONS
TYPICAL FOR FAN (NO ISOLATION)

UMD BAS Interface
VFD without Bypass Circuit

All VFD relays shall be mounted separately from VFD in junction box with flexible conduit with VFD.



BAS/VFD CONNECTIONS
TYPICAL FOR FAN (NO ISOLATION)

UMD BAS Interface
VFD without Bypass Circuit

- **Fan Arrays (Fan Wall)**

  Air moving equipment with Fan Arrays shall be integrated into controls with the following properties:

  Fan Arrays staging and speed control shall use CCMS BAS freely programmable native controller. “Black Box” controllers are not acceptable.

  Control of the fan array shall be performed directly by the CCMS BAS controller including the graphical editable programming code.

  It is acceptable and encouraged to integrate the associated Variable Frequency Drives (VFD) BACNet bus into the CCMS BAS system for monitoring purposes.

  The fan array shall have at minimum BAS hardwired points for each Fan:

  AI – Motor Current (Amps)
  DI – Fan Status
  DO – Fan Start / Stop
  AO – Fan Speed Control (0-10 VDC)

See "Variable Frequency Drives (VFD) Monitoring and Control" section for BAS interface requirements.

Demand Limit:

The CCMS BAS shall be programmed to include three building wide global/group demand limiting command levels to allow the CCMS operator, with administrator password access, to manually initiate the demand limiting sequence. The sequence shall be written to allowing for additional logic allowing automatic level indexing in addition to the manual user intervention.

Group:

A demand limit Group command shall include an AHU and/or its associated VAV's.

Group Commands:

From a common GUI screen, the CCMS operator shall be capable of selecting the following functions per group:

- Enable/Disable the demand limit sequence
- Set duration of an event through time schedule
- Select the demand limit level

Levels:

- Level 1: Shall command the group of VAV heating and cooling setpoint offset values from 0 °F to -3°F/+ 3°F, respectively.
- Level 2: Shall force the terminal units to minimum air flow by commanding the group of VAV heating and cooling setpoint offset values from 0 °F to -15°F/+ 15°F, respectively AND Command the associated AHU into recirculation mode (outside air damper closed, return air open) and reset the supply air temperature setpoint to 65 °F (adj.).
- Level 3: Shall command the group of VAVs and associated AHU into the Unoccupied Mode.
- Level 4: Shall command mixed box AHU Dampers to recirculate and associated exhaust fans off. VAV shall remain in Normal Mode.

Terminal Unit Exemptions:

The system shall allow the CCMS operator to set an individual VAV's to an Exempt Status where the Zone Temperature setpoint offsets shall remain at 0 °F for the Level 1 or 2 demand limit modes. The Exemption shall not apply for the demand level 3 mode.

Summary Reports:

The user shall be able to identify the following in summary form:
Terminal units set to exempt status
Level 1 Offsets
Level 2 Offsets

Graphical User Interface (GUI) representation of Demand Limit summary page:

All relevant points shall be audit and trend logged.
Graphical representation of the building profile shall include the following summary data:

VAV Group

Total Number of VAV's in group
Total Primary Air Volume (Input)
Total Primary Air Volume (Output)
Average Heating and Cooling %
Minimum, Maximum and Average Zone Temperatures
Minimum, Maximum and Average Zone Temperatures Setpoints
Global VAV Offset setpoints
Associated AHU

Supply Air Temp and Setpoint
Static Pressure and Setpoint
Chilled and Hot Water Valve Positions
Supply and Return Fan VFD Speed
Outside and Return Air Damper Position

General:
Demand Limit Mode Level
Outside Air Temperature and Humidity
Steam or Hot Water power and energy meter data, if available
Chilled Water power and energy meter data, if available.
Electrical power and energy meter data, if available.

Building vitals (Identification of cooling and heating plant, building number, use, size and age)

- **VAV graphical summary**

  The ATC contractor shall provide a VAV graphical summary screen(s) which includes the following points:

  1. Zone Temperature
  2. Zone Temperature Cooling Setpoint
  3. Zone Temperature Heating Setpoint
  4. Supply Temperature
  5. Supply Control Volume (controller output (cfm))
  6. Supply Volume (controller input (cfm))
  7. Cooling %
  8. Heating %
  9. Location room number

- **BAS IP Controller Local Area Network numbering scheme**

  BAS IP Controller Local Area Network and Building IP Router numbering scheme.

  For Tridium N4 applications, the contractors shall also provide the Pass Phrase for the JACE platform.

  Primary Building BAS Local Area Network (LAN)

  Primary LAN represents the IP addressing scheme for Building BAS routers and JACES shall use the following format.

  Where VVV= Vendor Number, RR=Router number (defined by vendor)

  010.000.VVV.1RR
  VVV=
  1=CCMS
  2=Capron
  3=SBT
  4=Primary Systems
  5=Alberio/EMS

  Secondary Building BAS Local Area Network (LAN)

Secondary LAN represents the IP addressing scheme for Building BAS controllers under the BAS routers and JACES, and shall use the following format.
Secondary LAN
0WW .0FF .0SS. DDD

WW=WING
FF=FLOOR
SS=SYSTEM TYPE
DDD=DEVICE ADDRESS (MAC)

SS
1=Air Systems
2=Water Systems
3=Terminal Unit
4=Lighting
5=Misc
6=Third Party (VFD's, Humidifiers, Etc).

- **Metering**

Meters shall be approved by FM Engineering and Energy Meter Shop and College Park Energy. Refer to the DCFS Utility Metering Section 33.00.00

Real time meter data is a required input to the BAS System. The meter data is compared with building occupancy and comfort levels and is an input to the CCMS Building Automation System (BAS) for Demand Shedding.

Meter data is required by the UMD Utilities Group and Energy Plant for billing, demand monitoring and trending of Campus Utilities.

Integration of the meters and flow computers supported by the UMD Meter Shop and the CCMS Group under the HVAC Group provide one meter source for all campus customers.

The BAS Vendor shall install adequate controllers to be able to read and display a minimum of 40-integrated points from each flow computer and meter.

The BAS communication to these meters is accomplished via MODBUS or BACNET over RS485. Communications protocol for each steam meter shall be coordinated with the Meter Shop.

The UMD Meter shop will approve points list for each meter and display format for each point (KWH, Tons, BTUs, Etc.).

At a minimum the instantaneous point and totalized points are required for energy and consumption points.

Calculation of totalized data using instantaneous values and pulses leads to a constant reconciliation effort between the BAS and Physical Meter and shall not be used.

The Meter Shop will provide the current list of approved meter products, flow computers, and communication translators (Hart to Modus, Etc.) for each project.

Additional Meter Information:

- Trending of meter data and storage on the campus server shall be setup by the ATC vendor. Jump tags and/or hyperlinks shall be setup to allow meter shop personal to jump between historical data and graphic displaying live data.
- Graphics for each meter shall be intuitive, easy to use and shall display all data read from the meter to allow the Meter Shop to easily verify proper communications between the meter and ATC system.
- Chiller Plant Metering. Each chiller plant shall have a Coefficient of Performance (COP) Graphic that sums BTU Metering and Electrical Usage and calculates instantaneous and totalized COP.
- Major SCUB System KWH data shall be required from all Chillers, CHWP, CWP & Cooling Towers for this COP calculation.
- The following are required inputs for the ATC System for each building.
  - Electrical Meters for all Service Entries.
  - Sub-Electrical Meters for various building entities (SCUB, Dining Services, Campus Rec, Residential Facilities, Etc)
  - Water Meters
  - BTU Meters (Chilled Water, Heating Hot Water, Domestic Hot Water if exported)
  - Steam Meters
  - Natural Gas Meters for applicable systems as identified by the Environmental Compliance Office

- **Lab Design**

Air volumes within Biological Science Labs (BSL) should be constant volume (CV).

In general, basis of design shall be medium pressure Venturi valve by Phoenix Controls. Design criteria shall consider valves orientation (horizontal, vertical).

Direct flow sensing of air stream not acceptable. Indirect 0- 10 VDC control voltage to air volume scaling shall be basis of design. Typical scales of 200 cfm per volt however proper valve sizing and scaling shall be determined from design scope room air valve schedule.

Lab Space air volume offsets less than 100 cfm are not recommended. In general, air volume offsets used to create the lab space pressure differential shall allow for the summation of accuracy tolerance of the Venturi air valves as well as the balancing test instruments.

Design criteria shall not locate BAS sensors in potentially contaminated air streams.

BAS controls contractors zone controller shall be freely programmable and associated control program shall fully accessible from the CCMS BAS.

In general, the BAS zone controller shall modulate the Supply and General Exhaust air valves, all other air valves shall be controlled locally and provide volume feedback (cfm/volt) back to the BAS zone controller.

Labs built with a fume hood(s) shall use high speed Venturi valves throughout the lab space so that zone pressurization can be maintained for all conditions.

In lab pressure zones, standard VAV terminal units shall not be mixed with Venturi valves types so that zone pressurization is maintained consistently across the air volume range.

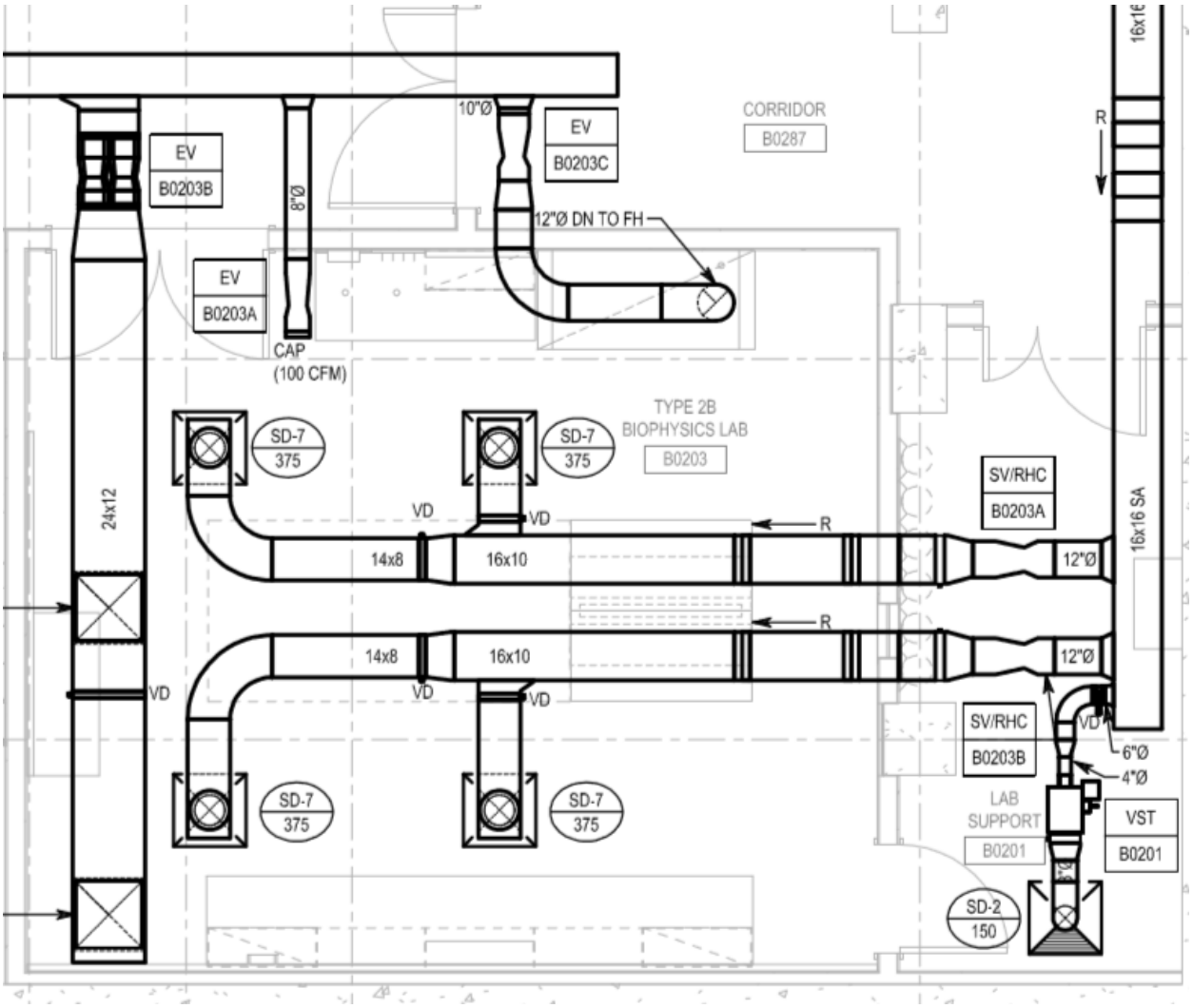
Low speed Venturi Valve control may be used in non-hood tracking pair applications.

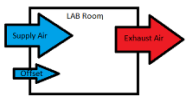
Occupancy Sensing shall be primary sensing point used for Air Exchange (ACH) rate indexing. Lab design class rating shall determine ACH rates.

Only Passive Occupancy sensor technologies shall be used for animal labs.

New Lab design or retrofit should place air valves and terminal units in corridor space whenever possible so that maintenance and repairs can be performed without the need to enter the space.

New Lab design or retrofit should place associated controls in corridor space, above door, so that repairs can be performed without the need to enter the space.





Air Exchange (ACH) Rate Calculation - Air Exchange per Hour

ACH = 60*Q/(Vol);
Where Q = Volumetric flow rate of air in cubic feet per minute (cfm)
Vol = Room Volume = cubic feet (Ft^3)

Laboratory Ventilation		
Laboratory Safety Level (LSL)	Occupied	Unoccupied
	Min ACH	Min ACH
LSL-1	4	2
LSL-2	6	3
LSL-3	8	4
LSL-4	8	8
Chemical Storage Room	6	6

Lab Safety Levels shall be adjustable from the CCMS BAS.

- **ACTUATORS**

It is the intent to use Electronic actuation whenever possible. The university is in the process of phasing out pneumatic operation across campus.

Control: Electronic actuators shall be modulated directly by 0-10 VDC control signal.

Power: Supply power shall be 24 VAC or 120 VAC for high torque applications.

Torque: Minimum torque required X 1.5 rating of actuated device. Actuators to have spring fail safe return capacity where required.

Actuators, at minimum required NEMA 4 housing, if installed in exposed outside air or other potentially damaging environmental conditions.

Installer shall mark damper shafts, permanently etched, indicating blade closed position.

Dampers and valves must be spring return and rated for required torque for fail safe positioning in case of the Freezestat trip, loss of signal or power loss.

Approved Manufacturer:

- Belimo
- Siemens
- Honeywell
- Bray

- **CONTROL VALVES**

Modulating water valves will generally be Pressure Independent valves with ball type equal percentage characteristic.

Pressure independent compensation shall use conventional spring based pressure regulator.

Valves using integrated flow sensing and/or internal flow logic control are not acceptable.

Valves shall be selected based design documents scheduled flow requirements and specification, including equipment coil capacity, close off pressure and not exceed the maximum flow requirement by more than 20%.

Valves shall not be selected more than two line sizes.

The valves shall require no maintenance or include replaceable cartridges.

Control valve actuators, at minimum required NEMA 4 housing, if installed in exposed outside air or other potentially damaging environmental conditions.

A separate output from the BAS shall be provided for each control valves.

Isolation Valves shall typically be butterfly type.

If not specified the valve fail positions (loss of power) shall be as follows:

- Lab and Non-lab terminal unit control water valves shall fail in place.
- Lab and Non-lab terminal unit control steam valves shall fail closed.
- Air Handling Units chilled and pre-heat water valve shall fail open using integral spring
- Air Handling Units heat steam valve shall fail closed using integral spring

Acceptable Manufacturers for valves with diameters 2 ½ inches or less:

- Belimo
- Siemen's
- Bray

Acceptable Manufacturers for valves with diameters greater than 2 ½ inches shall use Flow Control Delta P.

Flow Control Delta P valve shall use Bray or Belimo Actuators.

- **IP Devices**

A single IP is dedicated to the building. Buildings with multiple JACE's will require an Ethernet IP Router.

Preference: Contemporary Control Model: EIPR-E

All secondary devices on a JACE shall communicate on the secondary IP port.

A Bacnet IP to MS/TP router shall be used to improve JACE CPU resource usage by offloading the task of MS/TP token passing.

Preference: Bacnet-Model BASRTLX-B

Modbus-Model BASGLX-M1

All devices on a network shall be of the same manufacturer.

No repeaters allowed on the network.

No more than 30 devices on a network.